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Hurricane Katrina

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Introduction: Hurricane season runs from June 1 to November 30 every year as thunderstorms form over the hot moist air of the Atlantic Ocean. Sometimes these storms come across the ocean, intensifying before they run into the islands of the Caribbean and coastal areas of the southeastern United States. In 1954, Hurricane Hazel passed over Richmond, Virginia. In 1969, Camille became Virginia's worst natural disaster. In 1986, we experienced Charley and in 1989 we had Hugo. In 1992, Hurricane Andrew destroyed Homestead, Florida (near Miami). The following couple of years were somewhat quiet until the season picked back up in the summer of 1995 with Opal, Bertha and Fran in 1996, Bonnie in 1998, Dennis and Floyd in 1999, Gustav in 2002, Isabel in 2003, and Bonnie, Charlie, Gaston, Ivan and Jeanne in 2004. Throughout Virginia's history, over 69 eyes of cyclones have passed over the state and 11 have made landfall within 60 miles of Virginia's coasts (<http://www.vaemergency.com/newsroom/history/hurricane.cfm>). The 2005 hurricane season was the most active season on record resulting in 27 named storms although **NONE** passed through Virginia.

Hurricane Katrina was the eleventh named storm and ended up being the sixth most powerful Atlantic hurricane ever recorded and the third most destructive hurricane to make landfall in the United States. Katrina formed in the western Atlantic Ocean as a tropical depression over the Bahamas on August 23, 2005. Warm water and moisture-rich air provided energy for the storm system, causing it to strengthen and become a tropical storm, then a hurricane. When Hurricane Katrina moved into the Gulf of Mexico it strengthened, quickly becoming a category 5 hurricane. Luckily, it weakened to a category 3 hurricane prior to landfall. Despite this, Katrina still caused severe damage in the Gulf coast states of Louisiana, Mississippi, and Alabama. Most notably, Katrina's storm surge flooded 80% of New Orleans as the levees were breached, caused at least 1836 deaths, and an estimated \$81.2 billion dollars in damages.

History and Basics:

Weather satellites collect latitude and longitude coordinates to allow people to plot the paths of hurricanes and make predictions and advisories as to where they will make landfall. The National Hurricane Center tracks the hurricanes and issues their best estimate as to when and where a hurricane will hit and possible intensity levels. A tropical depression is an organized system of clouds and thunderstorms with a defined surface circulation and maximum sustained winds of 38 miles per hour, while a tropical storm has maximum sustained winds of 39-73 mph. A hurricane has a well-defined surface circulation with sustained winds of 74 mph or greater and are categorized by their winds speeds. Category 1 is the weakest and Category 5 is the strongest. If a hurricane is predicted to make landfall within 24-36 hours, the area affected is put under a *hurricane watch*. If a hurricane is predicted to make landfall in less than 24 hours, that area is put under a *hurricane warning*.

The deadliest part of a hurricane is the storm surge - a wall of ocean water pushed by the winds of a hurricane. This storm surge can come ashore up to 12 hours prior to landfall and can raise the sea level up to 25 feet. The calm "eye" of the hurricane can be up to 40 miles wide and often fools people into believing the storm is over resulting in injuries and fatalities. The eye wall, the winds around the eye, have the most severe winds. The death of a hurricane results from the loss of moisture and warm water. Upon landfall (or crossing an island), hurricanes begin to die out due to a lack of the moist, warm water which helps to intensify them. Higher latitude (cooler waters) can also cause a hurricane to dissipate.

Prior to 1953, hurricanes were named by where they hit or their coordinates. In 1953, hurricanes began having female names to help identify them in tropical waters, especially when there were multiple storms occurring simultaneously. It wasn't until 1979 that the hurricanes began alternating between male and female

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names in alphabetical order in a six-year rotating list. These names are used repeatedly unless they are retired due to substantial damage or death.

Names for Atlantic Basin Tropical Cyclones

2006	2007	2008	2009	2010	2011
Alberto	Andrea	Arthur	Ana	Alex	Arlene
Beryl	Barry	Bertha	Bill	Bonnie	Bret
Chris	Chantal	Cristobal	Claudette	Colin	Cindy
Debby	Dean	Dolly	Danny	Danielle	Don
Ernesto	Erin	Edouard	Erika	Earl	Emily
Florence	Felix	Fay	Fred	Fiona	Franklin
Gordon	Gabrielle	Gustav	Grace	Gaston	Gert
Helene	Humberto	Hanna	Henri	Hermine	Harvey
Isaac	Ingrid	Ike	Ida	Igor	Irene
Joyce	Jerry	Josephine	Joaquin	Julia	Jose
Kirk	Karen	Kyle	Kate	Karl	Katia
Leslie	Lorenzo	Laura	Larry	Lisa	Lee
Michael	Melissa	Marco	Mindy	Matthew	Maria
Nadine	Noel	Nana	Nicholas	Nicole	Nate
Oscar	Olga	Omar	Odette	Otto	Ophelia
Patty	Pablo	Paloma	Peter	Paula	Philippe
Rafael	Rebekah	Rene	Rose	Richard	Rina
Sandy	Sebastien	Sally	Sam	Shary	Sean
Tony	Tanya	Teddy	Teresa	Tomas	Tammy
Valerie	Van	Vicky	Victor	Virginie	Vince
William	Wendy	Wilfred	Wanda	Walter	Whitney

<http://www.nhc.noaa.gov/HAW2/english/basics.shtml>

If a hurricane watch is issued in your area, there are many things that you can and should do:

- Watch/listen to the weather on the television or radio.
- Make sure vehicles have fuel
- Check food (nonperishable) and water supplies (have two weeks worth of drinking water)
- Have cash
- Get a well-stocked first-aid kit
- Get batteries for flashlights and radios.

If you are told to evacuate, **LEAVE!** Hurricanes are deadly. They can lift cars, destroy houses, raise sea levels, and causing flooding due to torrential rains. Tornadoes are also expected. In this lab, you will use data from Hurricane Katrina to track its path.

Materials: Sharpened Pencil, colored pencils (optional) Atlantic Hurricane Tracking Map (provided by the American Red Cross), Hurricane data, lab sheet

Objectives:

Plot latitude and longitude coordinates on a map.

Compare and contrast weather advisories such as “hurricane watch” and “hurricane warning”

Give examples of actions to take to prepare for a hurricane

Describe the conditions necessary for a hurricane to develop and how it dies out.

Procedure

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1. Plot the position of the storm for each date on the Hurricane Tracking Chart to show the path of the hurricane. Place one finger (or ruler) on the longitude (N-S lines) coordinate and one finger (or ruler) on the latitude (E-W) coordinate and find where the coordinates intersect. Mark this point with a pencil, numbering each point in order to make it easier to locate where the hurricane was on each given date.
2. Connect the points with a line and draw arrows on the line indicating the direction the hurricane was moving. Ex.
3. Note the coordinates are generally 12 hours apart.
4. Answer all the questions about Hurricane Katrina following the data table. The data table is a list of the position of the center of circulation (the eye) of Katrina from August 24-31. The latitudes listed are north of the equator and the longitudes are west of the Prime Meridian. Wind speeds are in knots (1 knot = 1.15 mph, 120 knots = 138 mph).

Selected Data For Hurricane Katrina

	Date/Time (2005)	Latitude (°N)	Longitude (°W)	Wind Speed (knots)	Pressure (millibars)	Status
1	24/0000	23.4	75.7	30	1007	Tropical Depression
2	24/1200	24.5	76.5	35	1006	Tropical Storm
3	25/0000	26.0	77.7	45	1000	Tropical Storm
4	25/1200	26.2	79.0	55	994	Tropical Storm
5	26/0000	25.9	80.3	70	983	Hurricane-1
6	26/1200	25.1	82.0	75	979	Hurricane-1
7	27/0000	24.6	83.3	90	959	Hurricane-2
8	27/1200	24.4	84.7	100	942	Hurricane-3
9	28/0000	24.8	85.9	100	941	Hurricane-3
10	28/0006	25.2	86.7	125	930	Hurricane-4
11	28/1200	25.7	87.7	145	909	Hurricane-5
12	28/1800	26.3	88.6	150	902	Hurricane-5
13	29/0000	27.2	89.2	140	905	Hurricane-5
14	29/0006	28.2	89.6	125	913	Hurricane-4
15	29/1200	29.5	89.6	110	923	Hurricane-3
16	30/0000	32.6	89.1	50	961	Tropical Storm
17	30/1200	35.6	88.0	30	985	Tropical Depression
18	31/0000	38.6	85.3	30	994	Extratropical

References

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Analysis Questions

1. Look at the picture on the front of this lab. In what direction was this storm system rotating? Based on what you have learned in meteorology, how could you still know the direction the system is rotating even if you didn't have the picture?
2. Using your chart, in which state did Katrina make landfall first?
3. If the coordinates are 24 hours apart, at what latitude/longitude was a Hurricane Warning issued?
4. Using the data table, what is the difference between the highest and lowest air pressure readings on the data table? *Show your work.*
5. Identify the wind speed and air pressure on August 28th at 18:00UTC. Be sure to include the correct units.
a) wind speed = _____ b) air pressure = _____
6. *In general*, how was wind speed changing (a) before August 28th at 18:00UTC and (b) after August 28th at 18:00UTC?
a) _____ b) _____
7. *In general*, how was the air pressure changing (a) before August 28th at 18:00UTC and (b) after August 28th at 18:00UTC.
a) _____ b) _____
8. Based upon your answers to questions 6 and 7, what is the general relationship between changes in air pressure and wind speed in a hurricane?
9. From 00:00UTC on August 26th to 18:00UTC on August 28th, Hurricane Katrina strengthened significantly. According to the map, where was Katrina located at these times? What did this area provide to the storm to help strengthen it so much?
10. What caused Hurricane Katrina to slow down to a tropical depression on August 30th?
11. According to this lab and lecture, which region of the United States is the most vulnerable to hurricanes?
12. What are the two main conditions that would cause a hurricane to die out?
13. Describe two things that you and your family can do to prepare for a hurricane.